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Yakima Regional Wastewater Treatment Plant Class II Inspection, October 5-7, 1992

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ABSTRACT

A Class II Inspection was conducted October 5-7, 1992, at the Yakima Regional Wastewater Treatment Plant. The Yakima facility provides secondary treatment of domestic wastewater for the City of Yakima and adjoining urban areas. It also applies untreated wastewater from several food processing plants to sprayfields located along the Yakima River. Inspection data found that Yakima was providing adequate treatment for most pollutants limited by the NPDES permit. Total ammonia and fecal coliform effluent concentrations were of some concern. Influent loading for BOD_5 exceeded monthly average design criteria included in the NPDES permit. Influent flow exceeded 85% of design criteria. Revising plant criteria to reflect recent plant upgrades or submitting a plan and schedule to the Department of Ecology for the maintenance of adequate treatment is recommended. Differences in the influent wastewater quality of the plant's two influent channels were noted and it was suggested that Yakima evaluate the effectiveness of their current practice of sampling only one of those channels for NPDES permit parameters. All effluent organic compound concentrations were within EPA water quality criteria. Effluent concentrations of copper, lead, and silver exceeded EPA chronic water quality criteria for receiving waters. Effluent bioassays provided evidence of toxic effects. The toxicity may have been related to chlorine residual. Sodium adsorption ratio, pH, and coliform concentrations in industrial wastewater were of concern for sprayfield application. The inspection identified high fecal coliform counts and small to moderate organic/metal concentrations in the industrial influent.

INTRODUCTION

A Class II Inspection was conducted at the Yakima Regional Wastewater Treatment Plant on October 5-7, 1992. Guy Hoyle-Dodson and Marc Heffner, environmental engineers for the Washington State Department of Ecology (Ecology) Toxics, Compliance, and Groundwater Investigations Section, conducted the inspection. Phelps Freeborn, permit manager for the Washington State Department of Ecology Central Regional Office, requested the inspection; and provided both assistance during the inspection and information on the STP's treatment and compliance history. Assisting on-site was plant process control supervisor Joe Schnebly. Arnold Swain, swing shift chief operator; Bruce Bates, assistant superintendent; and Chris Waarvic, plant director provided additional information at various stages of the inspection.

The Yakima Regional STP provides secondary treatment of domestic wastewater for the city of Yakima and several adjoining urban areas. Effluent discharges to the Yakima River. The facility also provides sprayfield application for wastewater from several industrial food processing plants. The State of Washington regulates the Yakima STP through NPDES permit WA-002402-3, (expiration date: June 29, 1993).

Ecology conducted the Class II Inspection to identify potential areas of concern and to assist in writing a new permit. Specific objectives include:

1. verify compliance with NPDES permit limits,
2. characterize wastewater toxicity with chemical scans and bioassays,
3. characterize sludge toxicity with chemical scans,
4. evaluate treatment plant performance and plant design,
5. assess facility loading, and
6. assess permittee's self-monitoring through split sample analysis.

SETTING

Domestic Wastewater Treatment

The Yakima Regional Wastewater Treatment Plant is located in Yakima County, Washington, on the east side of the city of Yakima (Figure 1). The facility uses trickling filters followed by an activated sludge process. Sludge is anaerobically digested.

The plant has evolved over 35 years from a simple trickling filter plant serving only the city of Yakima to its present configuration as a regional wastewater treatment facility. In 1983 aeration basins were added to upgrade the facility's activated sludge treatment capacity. The plant also improved its anaerobic sludge digestion system to enhance sludge reduction and disposal. More recently, an odor reduction system was added which includes a plant-wide gas collection system, domes on the trickling filter, and gas treatment towers. During the inspection a new chlorination/dechlorination system was just beginning operation.

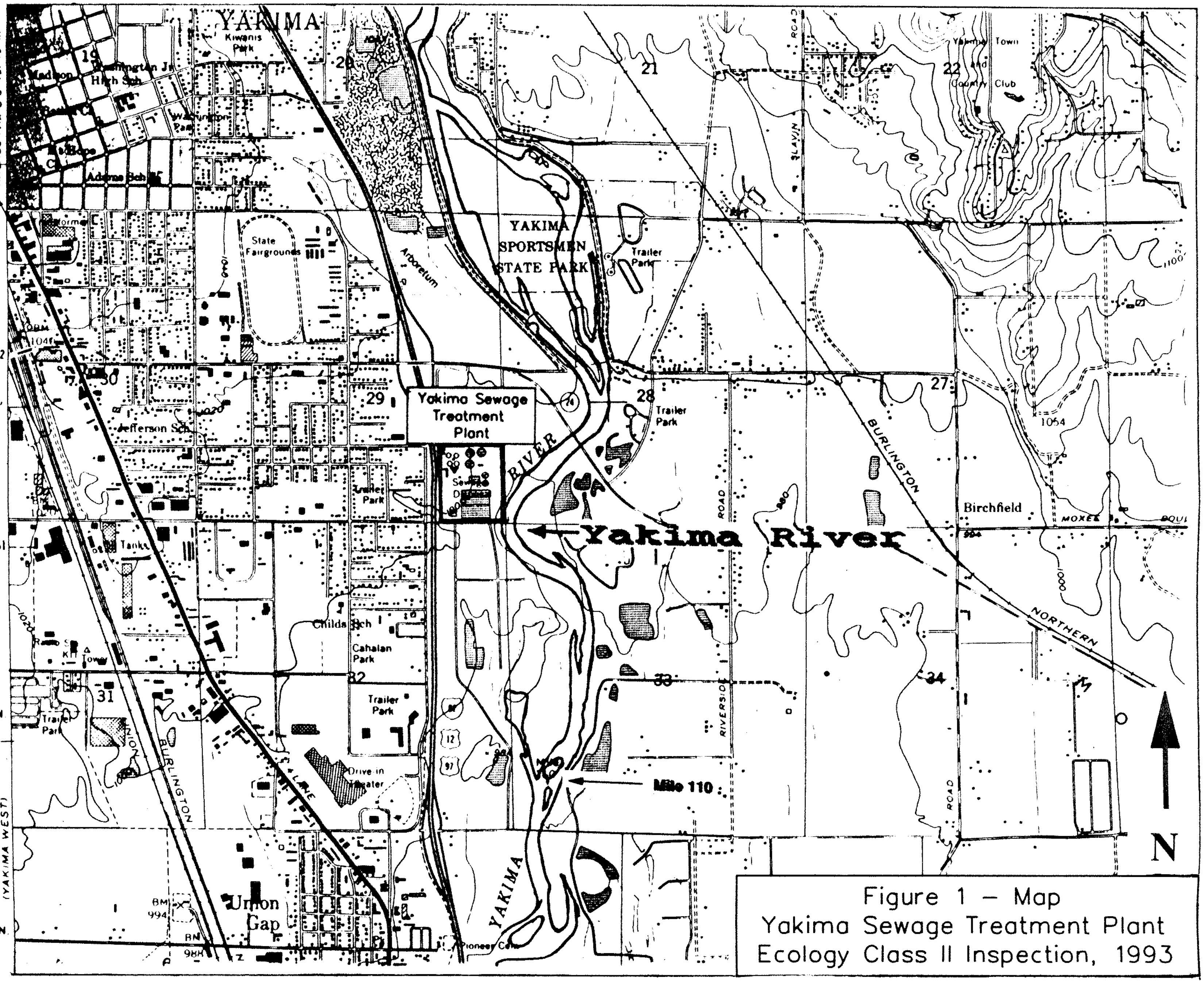


Figure 1 – Map
Yakima Sewage Treatment Plant
Ecology Class II Inspection, 1993

Three main domestic influent lines convey wastewater to the plant's influent diversion structure. Only minimal mixing occurs in the diversion structure before the flow is split into two separate channels. Visual inspection indicated that the sewage quality in these two channels differ from one another. During periods of lower flow only one channel may be used.

Each channel includes mechanical bar screens, an aerated degritter, and a Parshall flume (Figure 2). Solids from the degritters are dewatered and trucked to landfills. After the degritters, operators periodically add septage to the eastern channel. Meters in each channel measure instantaneous and totalized flows at the Parshall flumes. The channels are joined at a flow splitter prior to the primary clarifiers, although mixing is minimal. Flow from each side of the flow splitter is directed into one of two pairs of primary clarifiers.

After sedimentation the primary clarifier effluents flow to a common wetwell. Approximately 1 MGD of primary clarifier effluent was pumped directly into the plant's activated sludge aeration basins to optimize aeration basin loading. The balance of the flow is routed to single stage recirculating trickling filters. Two trickling filter towers are operated in parallel.

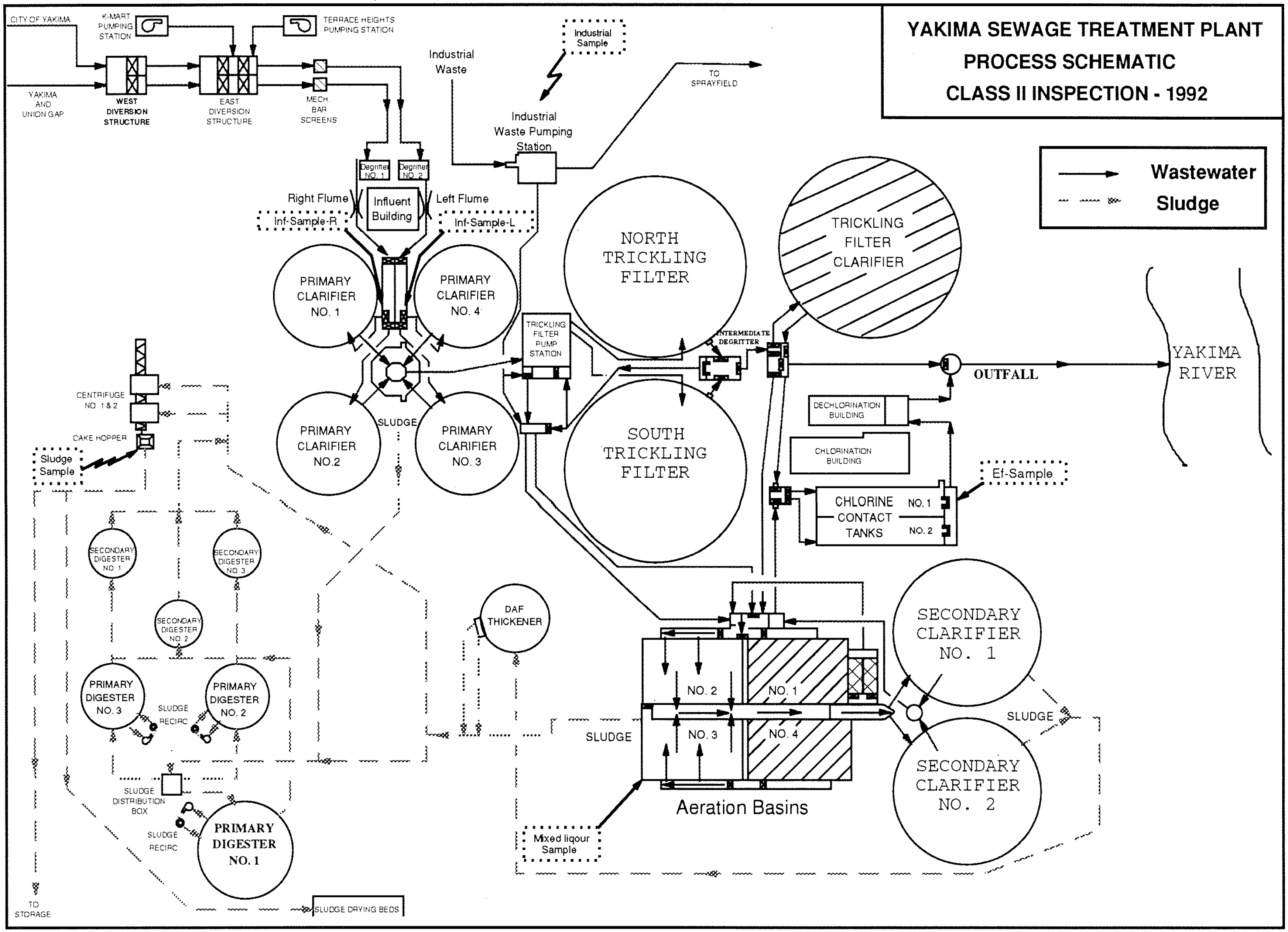
The trickling filters use a rock medium with a forced air aeration system. The installations are covered by domes for odor control. The odor reduction system collects gases from the domes as well as from several other points throughout the plant. Scrubbing towers treat the gases with NaOH and Cl_2. Scrubber water overflow is directed back to the headworks. An intermediate degritter follows the trickling filter. This is principally used to remove snails if they become a problem, although few, if any, snails inhabited the trickling filters at the time of the inspection. The degritter returns grit slurry to the headworks. An optional clarifier following the trickling filters was not in use at the time of the inspection.

Flow from the trickling filters is next routed to the activated sludge aeration basins. During the inspection two of the four aeration basins were in use. Aeration is by fine bubble diffusers. In addition to the trickling filter effluent and the primary clarifier effluent diversion, the basins also accept the wastewater from dewatered sludge. Groundwater from beneath the basins was also pumped into the aeration basins. The operator reported that this was done to stabilize the soil beneath the basins.

From the aeration basins, effluent is discharged to two secondary clarifiers. Secondary clarifier effluent is sent to a chlorine contact chamber for disinfection. During the inspection operators controlled chlorination by a flow proportional system. A chlorine delivery system with direct measurement of effluent chlorine concentrations had been installed, but was not functioning during the inspection. Dechlorination with SO_2 is the final step before effluent discharges to the Yakima River via a submerged pipe.

The sludge handling system consisted of: 1) a dissolved air floatation (DAF) thickener, 2) primary and secondary anaerobic digesters, 3) sludge centrifuges, 4) drying beds, and 5) a settling lagoon. Sludge from the primary clarifiers was pumped directly to the primary anaerobic digesters. Secondary clarifier sludge was first concentrated by the DAF thickener,

FIGURE 2


YAKIMA SEWAGE TREATMENT PLANT
PROCESS SCHEMATIC
CLASS II INSPECTION - 1992
Wastewater
Sludge
CITY OF YAKIMA
K-MART PUMPING STATION
TERRACE HEIGHTS PUMPING STATION
YAKIMA AND UNION GAP
WEST DIVERSION STRUCTURE
EAST DIVERSION STRUCTURE
MECH. BAR SCREENS
Industrial Waste
Industrial Sample
Industrial Waste Pumping Station
TO SPRAYFIELD
Degritter NO. 1
Degritter NO. 2
Right Flume
Influent Building
Left Flume
Inf-Sample-R
Inf-Sample-L
PRIMARY CLARIFIER NO. 1
PRIMARY CLARIFIER NO. 4
PRIMARY CLARIFIER NO.2
PRIMARY CLARIFIER NO. 3
SLUDGE
NORTH TRICKLING FILTER
SOUTH TRICKLING FILTER
TRICKLING FILTER CLARIFIER
TRICKLING FILTER PUMP STATION
INTERMEDIATE DEGRITTER
OUTFALL
YAKIMA RIVER
DECHLORINATION BUILDING
CHLORINATION BUILDING
Ef-Sample
CHLORINE CONTACT TANKS
NO. 1
NO. 2
CENTRIFUGE NO 1 & 2
CAKE HOPPER
Sludge Sample
SECONDARY DIGESTER NO. 1
SECONDARY DIGESTER NO. 3
SECONDARY DIGESTER NO. 2
PRIMARY DIGESTER NO. 3
PRIMARY DIGESTER NO. 2
SLUDGE RECIRC
SLUDGE DISTRIBUTION BOX
PRIMARY DIGESTER NO. 1
TO STORAGE
SLUDGE DRYING BEDS
DAF THICKENER
SLUDGE
NO. 1
NO. 2
NO. 3
NO. 4
Aeration Basins
Mixed liqour Sample
SECONDARY CLARIFIER NO. 1
SECONDARY CLARIFIER NO. 2
SLUDGE

then the thickened sludge was sent to the primary anaerobic digesters. A centrifuge provided final dewatering for most of the treated sludge. Alternatively, a small amount of treated sludge was sent to sludge drying beds. Drivers trucked dried sludge from the centrifuge and drying beds to a storage area. Sludge was eventually applied to agricultural land. A sludge lagoon was filled to capacity and not receiving additional sludge or digester supernatant at the time of the inspection.

Industrial Wastewater Treatment

Industrial influent from a few large food processing plants arrived at the plant in a dedicated sewer. Industrial flow is mostly seasonal with the largest flows from August through October. Del Monte Food Corporation generates approximately 85% of the industrial influent, with Indian Summer-American Foods, Inc. contributing the bulk of the remainder. The latter is a vinegar processor and generally operates year-round. Screens at the industrial plants and a rotating screen at the treatment plant remove large solids from the industrial influent. Wastewater is then pumped without further treatment to sprayfields which lie between the Yakima plant and the Yakima River. Forage crops had been planted, but during the inspection growth appeared to be marginal. Weeds were also a problem.

Operators determined industrial flow rates from sprayfield pump records. Peak season flow was estimated to be 1 MGD. During off seasons (cold weather/winter) the sprayfield is shut down and industrial wastewater is treated along with the domestic wastewater. Such combined treatment at higher industrial flow rates was reported to cause problems with STP operation. Yakima recently initiated ground water monitoring at the sprayfields, but no conclusions on treatment effectiveness have yet been reached.

PROCEDURE

Ecology collected both grab and composite samples at the STP. Influent composite samples were collected from each channel at the flow splitter prior to the primary clarifiers. An effluent composite sample was collected at the end of the chlorine contact chamber. A composite sample was also collected of the industrial wastewater at the wetwell. Ecology Isco composite samplers collected equal volumes of sample every 30 minutes for a 24-hour period. Grab samples were collected from both channels of the influent, from the aeration basins, from the industrial wetwell, and from the chlorine contact chamber discharge. Grab samples were also collected from the groundwater pumped from beneath the aeration basins, the Yakima River, and from a sewer of uncertain origins passing beneath the sprayfields and discharging into the Yakima River. Sample locations are summarized in Appendix A and noted on Figure 2.

Yakima also collected influent and effluent composite samples. Sampling locations generally corresponded to those of Ecology samples. The exception was the influent sample, where Yakima collected only from the right influent channel. Their sample station was very near the Ecology composite sampler in this channel. Sampling periods and volumes replicated Ecology sampling procedures.

Ecology and Yakima samples were split for analysis by both Ecology and Yakima labs. Parameters, samples collected, and schedules are summarized in Appendix B.

Samples for Ecology analysis were placed on ice and delivered to the Ecology Manchester laboratory. Chain-of-custody procedures were observed throughout. Appendix C summarizes analytical procedures and the laboratories performing the analysis.

QUALITY ASSURANCE\QUALITY CONTROL

Sampling

Sampling quality assurance included priority pollutant cleaning of sampling equipment. (Appendix D). Sampling in the field followed all protocols for holding times, preservation, and chain-of-custody set forth in the Manchester Laboratory User Manual (Ecology 1991).

General Chemistry Analysis

All holding times were within criteria. Procedural blanks were acceptable. Instrument calibration and standard reference material were within appropriate control limits.

Metals Analysis

All holding times were within criteria. Procedural blanks were generally acceptable except for cadmium in the aqueous samples. Results for cadmium, which were less than 10 times the blank concentration, were qualified to indicate potential contamination from the sample preparation process. The laboratory qualified these parameters with "B."

Instrument calibration, spike recoveries, duplicate spike recoveries, and standard reference material were generally within acceptable control limits. Exceptions were:

1) Copper was outside the relative percent difference window for precision. The laboratory qualified copper results "E."

2) Thallium is qualified with "J," denoting estimated results because of problems with standard reference material recovery.

VOAs, BNAs, and Pesticides/PCBs

Holding times were generally within criteria. Method blanks for both water and sludge samples were generally acceptable. Exceptions were VOA compounds detected at concentrations less than five times the method blank concentration and BNA compounds detected at concentrations less than ten times the method blank concentration. The lab qualified these compounds with the "U" qualifier to indicate that these analytes were not detected at a level above the suspected contamination amount.

Initial and continuing calibrations, matrix spikes, and surrogate recoveries were generally within acceptable QC limits. The lab qualified all exceptions exceeding the maximum 30% relative standard deviation (RSD) for initial calibration standards with the "UJ" qualifier. Exceptions exceeding 25% deviation between the initial and continuing calibration standards were also qualified with the "UJ" qualifier.

Bioassays

Control results and reference toxicant results were within acceptable ranges for all organisms tested. Test environment data were generally within acceptable ranges. Exceptions included:

1) The test procedure for *Ceriodaphnia dubia* varied slightly from EPA recommendations in that a 13-ml test solution was used instead of a 15-ml test solution. Since validation criteria were met, this did not affect the outcome of the test.

2) Chlorine residual was measured in the sample at a concentration that may have been toxic to aquatic organisms. Chlorine residual measured in the laboratory was 0.31 mg/L. Since chlorine residual is an NPDES permit limited parameter, its effect on bioassays is of some pertinence. Consequently, the inspector did not request sample dechlorination. Since the inspection Whole Effluent Toxicity (WET) guidelines have been changed to call for bioassays to be run on unchlorinated or dechlorinated effluent.

RESULTS AND DISCUSSION

Domestic Wastewater Treatment

Flow Measurements

Ecology measured instantaneous flows at the east and west influent channel's Parshall flumes. Typical flows were 7.5 MGD for the west channel and 7.7 MGD for the east channel. Yakima instantaneous flow meter measurements for each channel corresponded fairly well to calculated values, with differences less than 10%.

Yakima's flow totalizer reported the flow rate to be 12.9 MGD for the period from 21:00, October 6, 1992, to 21:00, October 7, 1992. This rate approached the 13.7 MGD monthly average design capacity, but was well below the 22.3 MGD design capacity for peak month average flow (Table 1). Historically, August, not October, is their peak month. The inspection flow and flow for the seven previous 24-hour monitoring periods were each greater than 85% of the design capacity for monthly average flow. Should flows frequently exceed 85% of monthly design capacity, the design capacity should be modified to reflect any plant improvements, or a plan and schedule for continuing adequate treatment capacity should be submitted to Ecology.

Table 3 – Influent NPDES Limits/Inspection Results – Yakima STP, 1992

		Inspection Data+			
		Ecology Composite			STP Composite
	Location:	Inf-E-R	Inf-E-L	Tot-Inf-E	Inf-Y
	Type:	E-comp	E-comp	TotalFlow	Y-comp
	Date:	10/6-7	10/6-7	10/6-7	10/6-7
	Time:	@	@	@	@
	Lab Log #:	418159	418160		418161
Parameter	NPDES Permit Limits				
Flow Loading (MGD)				12.9	12.9
Monthly Average	13.7				
Monthly Peak	22.3				
Instantaneous Peak	27				
BOD5 Loading (mg/L)		310	430	370	430
Average Monthly (lbs/D)	32700	16700	23100	39800	46300 #
TSS Loading (mg/L)		209	247	228	205
Average Monthly (lbs/D)	35000	11200	13300	24500	22100 #

Total — Average of left and right channel concentrations. Instantaneous measurements. found flows approximately equal in each channel.
Inf — Influent
E — Ecology sample
Y — Yakima sample
comp — Composite sample
@ — Composite sampling time: 08:00–08:00
L — Left side of the channel
R — Right side of the channel

\+ — Ecology analytical results

NPDES Permit Compliance

Effluent inspection results were generally less than weekly and monthly permit limits (Table 2). BOD_5, TSS, pH, and effluent flow rates were all within the monthly averages imposed by NPDES permit limits.

Calculation of the ammonia limit found the chronic criteria to be limiting (Table 2). The chronic criteria concentration, determined for the edge of the discharge dilution zone, was based on 15% of the river's lowest daily flow during the week of the inspection. Flow in the river varied substantially during the week due to the ending of the irrigation season, ranging from 1383 cfs on October 4 to 975 cfs on October 9. Total ammonia (NH_3) in the effluent exceeded the calculated NPDES permit chronic limit by 46%. Steps to reduce effluent NH_3 concentrations should be investigated. At the time of the inspection only two of the four aeration basins were in service. Conceivably, putting more aeration basins into service could be a solution.

The Ecology effluent fecal coliform grabs (250#/100mL & 3000#/100mL) exceeded the permit monthly average limit, one by a factor of 10 (Table 2). The highest value also surpassed NPDES permit weekly average limit. The geometric mean of the two Ecology fecal coliform grabs (866#/100mL) exceeded weekly averages. Chlorine residual concentrations showed some variability prior to dechlorination (Table 3). The higher fecal coliform result was associated with the lower chlorine residual prior to dechlorination. Varying degrees of dechlorination were also observed. Ecology results for samples collected after dechlorination ranged from 0.1 to 0.5 mg/L. Fine tuning the new chlorination and dechlorination systems should provide acceptable disinfection and avoid excessive chlorine discharges.

BOD_5 loading was high relative to the monthly average design capacity for prevention of facility overloading included in the permit (Table 1). The Ecology sample BOD_5 influent load (39800 lbs/day) appreciably exceeded the permit design capacity. The Yakima sample BOD_5 results (33400 lbs/day) also slightly exceeded the design capacity. Should BOD_5 loading frequently exceed 85% of design capacity, the design capacity should be modified to reflect any plant improvements, or a plan and schedule for continuing to maintain adequate treatment capacity should be submitted to the Department of Ecology. The Ecology sample TSS influent load (24500 lbs/day) was less than 85% of the NPDES permit design criteria.

General Chemistry/Plant Operation

General chemistry data are reported in Table 3. Inspection data showed good reductions (>90%) across the STP for TSS, BOD_5, BOD_{INH}, and COD (Table 4). Moderate reductions (>50%) were seen in TOC, total Kjeldahl-N, and total P. Reductions in NH_3-N were quite modest (< 3mg/L) and corresponding increases in NO_2+NO_3-N were also quite small (<0.1 mg/L). The nutrient data and the relatively high effluent NH_3 concentration suggest that there is little nitrification across the plant.

Table 2 - Effluent NPDES Limits/Inspection Results - Yakima STP, 1992

Parameter	NPDES Permit Limits			Inspection Data+ Ecology Composite	STP Composite	Grab Samples			
			Location:	Ef-E	Ef-Y	Ef-1	Ef-2	Ef-3	Ef-4
			Type:	E-comp	Y-comp	grab	grab	grab	grab
			Date:	10/6-7	10/6-7	10/6	10/6	10/7	10/7
			Time:	@	@	1055	1525	0825	1210
			Lab Log #:	418166	418167	418162	418163	418164	418165
	Monthly Average	Weekly Average							
BOD5									
(mg/L)	30	45		13	9.3				
(lbs/D)	4779	7168		1399	1001				
(% removal)	85			96	97				
TSS									
(mg/L)	30	45		13	17	12	9		
(lbs/D)	5250	7875		1399	1829	1291	968		
(% removal)	85			94	92	94	97		
Effluent Flow									
(MGD)++	22.3			12.9	12.9				
Fecal coliform									
(#/100 mL)	200 #/100ml	400 #/100ml						3000 J	250 J
pH (S.U.)									
	6.0 < pH < 9.0					7.53	7.35		
Total Ammonia (mg/L)	Maximum Value								
(NH3)				11.9	12.0	15.2	11.8		
(NH3-N)				9.78	9.85	12.5	9.66		
Acute* (NH3)	15.32								
(NH3-N)	12.59								
Chronic-1** (NH3)	6.32								
(NH3-N)	5.20								

* Calculated as the EPA one-hour average concentration criteria for ammonia (NH3) in the effluent; Average effluent pH=7.44; Average effluent temp=20.4°C

** Total ammonia criteria was calculated as the EPA four-day average concentration in the effluent that meets concentration criteria at edge of dilution zone.
The 1-day weekly low flow was provided from the Bureau of Reclamation guaging stations on the Yakima River during the week 10/4 through 10/10 was 975 cfs;
River pH = 8.25; River temp = 11.6°C; River Background NH3-N = 0.027mg/L.

Ef Effluent
E Ecology sample.
Y Yakima sample.
grab Grab sample.
comp Composite sample.
@ Composite sampling time: 08:00-08:00.
\+ Ecology analytical results.
++ Flow rate provided by Yakima STP (12.9 MGD).

Table 3 - Ecology General Chemistry Results - Yakima STP, 1992.

Parameter / Location:	Inf-1-R	Inf-2-L	Inf-3-R	Inf-4-L	Inf-E-R	Inf-E-L	Inf-Y**	Ef-1	Ef-1-A	Ef-2	Ef-3	Ef-4	Ef-E	Ef-Y
Type:	grab	grab	grab	grab	E-comp	E-comp	Y-comp	grab	grab	grab	grab	grab	E-comp	Y-comp
Date:	10/6	10/6	10/6	10/6	10/6-7	10/6-7	10/6-7	10/6	10/6	10/6	10/7	10/7	10/6-7	10/6-7
Time:	0919	0904	1430	1428	@	@	@	1055	1245	1525	0825	1210	@	@
Lab Log #:	418155	418156	418157	418158	418159	418160	418161	418162		418163	418164	418165	418166	418167
GENERAL CHEMISTRY														
Conductivity (umhos/cm)	495	655	2400	609	633	531	498	640		564			594	603
Alkalinity (mg/L CaCO3)					129	126	130						159	160
Hardness (mg/L CaCO3)					87.9	89.5	85.9						74.9	76.4
SOLIDS														
TS (mg/L)					835	775	783						415	
TNVS (mg/L)					327	240	243						234	
TSS (mg/L)	143	233	310	233	209	247	205	12		9			13	17
TNVSS (mg/L)					36	33	29						2	
% Solids														
% Volatile Solids(dry)														
OXYGEN DEMAND PARAMETERS														
BOD5 (mg/L)					310	430	310						13	9.3
BOD INH (mg/L)					290	380	300						11	6.9
BOD35 (mg/L)													50	
COD (mg/L)					631	737	615						64	64
TOC (water mg/L)	168	179	211	248	238	267	238	64.4		63.2			110	63.3
TOC (soil - % solids)														
NUTRIENTS														
Kjeldahl-N (mg/L)					25.3	33.8	13.7						12.8	13.4
NH3-N (mg/L)					10.2	13.8	11.0	12.5		9.66			9.78	9.85
NO2+NO3-N (mg/L)					0.218	0.138	0.023	0.171		0.089			0.196	0.113
Total-P (mg/L)					4.95	5.29	4.38	2.99		2.93			2.17	2.11
MISCELLANEOUS														
Oil and Grease (mg/L)	26 J	36 J	68 J	49 J				1 J		1 UJ				
F-Coliform MF (#/100mL)											3000 J	250 J		
T-Coliform MF (#/100mL)														
SODIUM ADSORPTION RATIO PARAMETERS														
HCO3 (mg/L)														
Ca (mg/L)														
Mg (mg/L)														
Na (mg/L)														
FIELD OBSERVATIONS														
Temperature (°C)	19	20.5	20.5	21.6				20.2	20.3	20.5				
Temp-cooled (°C)*+					2.6	2.8	10.5						2.9	10.3
pH	7.21	7.25	7.04	6.92	7.29	7.18	7.07	7.53	7.49	7.35			7.72	7.81
Conductivity (umhos/cm)	405	510	1760	510	425	450	420	550	520	480			510	510
Chlorine (mg/L)								0.6/0.3*	1.0/0.5*	0.6/0.1*	/0.2*	0.6/0.1*		

Inf	Influent	E	Ecology samples.
EF	Effluent	Y	Yakima samples.
grab	Grab sample.	dup	duplicate sample
comp	Composite sample.	J	The associated numerical results is an estimated quantity.
@	Composite collection times: 08:00-08:00.	UJ	The analyte was not detected at or above the reported estimated result.
L	Left side of channel in direction of flow.	*	Pre-dechlorination/Post-dechlorination
R	Right side of channel in direwction of flow.	**	Yakima collected sample from right channel.
A	Field measurement duplicate	*+	Refrigerated sample.

Table 3 - Ecology General Chemistry Results - Yakima STP, 1992.

Parameter II Location:	Ef-GC	Aer-Mix-1	Aer-Mix-2	Sludge	I-Ef-1	I-Ef-2	I-Ef-3	I-Ef-4	I-Ef-E	River 1	River 2	Ground	AgOut
Type:	grab-comp	grab	grab	grab	grab	grab	grab	grab	E-comp	grab	grab	grab	grab
Date:	10/6	10/6	10/6	10/6	10/6	10/6	10/7	10/7	10/6-7	10/6	10/6	10/6	10/7
Time:	AM&PM	1105	1600	1325	0955	1500	0900	1155	@	1050	1050	1612	1115
Lab Log #:	418168	418169	418170	418171	418172	418173	418174	418175	418176	418177	418178	418179	418180
GENERAL CHEMISTRY													
Conductivity (umhos/cm)	591				236	275			261	137			162
Alkalinity (mg/L CaCO3)	159								1U	62.8			
Hardness (mg/L CaCO3)									61.3	58.3			
SOLIDS													
TS (mg/L)									2790				
TNVS (mg/L)									121				
TSS (mg/L)		2270	2360		447	700			227			1	9
TNVSS (mg/L)		345	340						1U				
% Solids				23.6									
% Volatile Solids(dry)				67.2									
OXYGEN DEMAND PARAMETERS													
BOD5 (mg/L)									> 700				
BOD INH (mg/L)									> 700				
BOD35 (mg/L)													
COD (mg/L)									3720				
TOC (water mg/L)					1360	1680			1370			61.6	131
TOC (soil - % solids)				2.1									
NUTRIENTS													
Kjeldahl-N (mg/L)									12.4				
NH3-N (mg/L)									0.183	0.027	0.020	0.234	0.500
NO2+NO3-N (mg/L)									0.093			1.8	0.159
Total-P (mg/L)									0.977			0.217	0.161
MISCELLANEOUS													
Oil and Grease (mg/L)					3 J	8 J							
F-Coliform MF (#/100mL)							190000 J	220000 P					
T-Coliform MF (#/100mL)							> 400000	> 400000					
SODIUM ADSORPTION RATIO PARAMETERS													
HCO3 (mg/L)					1 U	1 U							
Ca (mg/L)					17.2	16.0							
Mg (mg/L)					4.87	4.78							
Na (mg/L)					12.9	18.0							
FIELD OBSERVATIONS													
Temperature (°C)		20.9			18.8	21.3				11.6	11.6	17.4	16.7
Temp-cooled (°C)*+									2.8				
pH		7.21			4.98	4.55			5.07	8.25	8.25	6.71	6.68
Conductivity (umhos/cm)		480			210	230			242	125	125	250	130
Chlorine (mg/L)	0.6/*						≤0.1						

gr-comp/GC Grab-composite
I Industrial discharge
Aer-Mix Aeraton Basin Mixed Liquor
Sludge Centrifuge sludge extract
* Pre-dechlorination/Post-dechlorination
*+ Refrigerated sample

River Receiving water: Yakima River
Ground Ground water pumped from beneath aeration basin
AgOut Stormwater pipe with inflitration from sprayfield
J The associated numerical results is an estimated quantity.
P Greater than.
U The analyte was not detected at or above the reported amount.

Table 4 – Ecology General Chemistry Results Percent Reduced – Yakima STP, 1992.

Parameter	Location:	Inf-E-R	Inf-E-L	Tot-Inf-E	Ef-E	Ecology	Inf-Y	Ef-Y	Yakima
	Type:	E-comp	E-comp	E-comp	E-comp	Percent	Y-comp	Y-comp	Percent
	Date:	10/6-7	10/6-7	10/6-7	10/6-7	Reduced	10/6-7	10/6-7	Reduced
	Time:	@	@	@	@		@	@	
	Lab Log #:	418159	418160	*	418166		418161	418167	
GENERAL CHEMISTRY									
Alkalinity (mg/L CaCO3)		129	126	128	159	−25%	130	160	−23%
SOLIDS									
TSS (mg/L)		209	247	228	13	94%	205	17	92%
OXYGEN DEMAND PARAMETERS									
BOD5 (mg/L)		310	430	370	13	96%	310	9.3	97%
BOD INH (mg/L)		290	380	335	11	97%	300	6.9	98%
COD (mg/L)		631	737	684	64	91%	615	64	90%
TOC (mg/L)		238	267	253	110	56%	238	63.3	73%
NUTRIENTS									
Kjeldahl-N (mg/L)		25.3	33.8	29.6	12.8	57%	13.7	13.4	2%
NH3-N (mg/L)		10.2	13.8	12	9.78	19%	11	9.85	10%
NO2+NO3-N (mg/L)		0.218	0.138	0.178	0.196	−10%	0.023	0.113	-391%
Total-P (mg/L)		4.95	5.29	5.12	2.17	58%	4.38	2.11	52%
TIN(mg/L)		10.4	13.9	12.2	10.0	18%	11.02	9.96	10%

Inf Influent
EF Effluent
E Ecology samples
Y Yakima samples.
L Left side of the influent channel
R Right side of the influent channel
* Average of left and right channel concentrations.
Average is based on approximately equal flows in the two channels.
comp Composite sample
@ Composite sampling time: 8:00 AM – 8:00 AM
TIN Total inorganic nitrogen (TIN = NH3-N + NO2-N + NO3-N)

There appear to be tangible differences in general chemistry concentrations between the left and right influent channels (Table 3). Visual inspection found differences both in color and occasional oil and grease sheens. Composites detected greater BOD_5, BOD_{INH}, COD, TOC, and TSS concentrations in the left channel than in the right. Conversely composite results for dissolved solids and conductivity in the right channel appreciably exceeded that in the left. Grab samples collected from the two channels at approximately the same time also found variability. During the inspection, Yakima personnel collected samples where the channels were interconnected but mixing appeared minimal. The Yakima sampling was primarily from the right channel and the data generated was quite similar to the Ecology right channel data. Yakima should determine whether the two channels are routinely different enough to necessitate sampling both channels to accurately determine influent loading.

Sample Splits

Ecology analysis of sample splits found a fairly reasonable match between Ecology and Yakima influent and effluent composite samples (Table 3). Exceptions were somewhat lower values for several Yakima oxygen demand parameter samples and a much lower value for the Yakima Kjeldahl-N influent sample. Of note was the observation that Yakima composite sample temperatures were generally seven to eight degrees centigrade higher than Ecology samples. It is unclear how long the Yakima samples sat in the lab prior to measuring the temperature. Yakima should assure that samples were being properly cooled during collection.

Comparison of Ecology's and Yakima's laboratories analysis of split samples produced mixed results (Table 5). Fecal coliform comparisons showed the greatest difference between analyses. Ecology's values for one effluent grab was nearly a factor of 100 times greater than Yakima's, while another effluent grab was only marginally greater. Both sets of industrial fecal coliform analyses were uniformly high. Yakima does possess laboratory accreditation from the Department of Ecology laboratory accreditation program, but this discrepancy may indicate problems. Yakima should review their fecal coliform protocol to assess test performance. It is suggested that they contact Ecology's laboratory accreditation program if assistance is needed.

Yakima's TSS results were slightly lower than Ecology's results. The most marked differential was the industrial effluent composite sample (I-Ef-E) where Yakima's results (627 mg/L) greatly exceeded Ecology's results (227 mg/L). The results of the Inf-E-L sample were also notably different.

BOD_5 and NH_3-N comparisons found Ecology's values slightly lower than Yakima's values (Table 5). Correlation between sets of data was very good (0.89 and 0.99, respectively). Linear regression analysis between six pairs for BOD_5 and four pairs for NH_3-N corroborated that Ecology's values were consistently lower. The actual difference between each pair of data appeared marginal.

The two chlorine residual splits analyzed found some variation between Ecology and Yakima results.

Table 5 – Split Sample Result Comparison – Yakima STP, 1992

Parameter	Location:	Inf-E-R	Inf-E-L	Inf-Y**	Ef-3	Ef-4	Ef-E	Ef-Y	I-Ef-3	I-Ef-4	I-Ef-E
	Type:	E-comp	E-comp	Y-comp	grab	grab	E-comp	Y-comp	grab	grab	E-comp
	Date:	10/6-7	10/6-7	10/6-7	10/6	10/6	10/6-7	10/6-7	10/7	10/7	10/6-7
	Time:	@	@	@	0825	1210	@	@	0900	1155	@
	Lab Log #:	418159	418160	418161	418164	418165	418166	418167	418174	418175	418176
	Laboratory										
TSS (mg/L)	Ecology	209	247	205			13	17			227
	Yakima Δ	220	116	172			10	11			627
BOD5 (mg/L)	Ecology	310	430	310			13	9.3			>700
	Yakima Δ	360	465	371			12	10			2155
NH3-N (mg/L)	Ecology	10.2	13.8	11			9.78	9.85			0.183
	Yakima Δ	13.4	15.7	–			13	–			1.23
F-Coliform MF (#/100ml)	Ecology				3000 J	250 J			190000 J	220000 P	
	Yakima				36	100			TNTC	TNTC	
T-Coliform MF (#/100ml)	Ecology								>400000	>400000	
	Yakima								TNTC	TNTC	
Chlorine (mg/L)	Ecology				0.2*	0.6*			≤0.1		
	Yakima				0.51*	0.51*			–		

Δ Yakima unsure how long composite samples were out of refigerator
@ 24 hour composite. Collection period: 0800 – 0800.
J The analyte was positively identified, but the associated value is an estimate.
TNTC Too Numerous To Count
– Analysis not provided

Inf Influent samples.
Ef STP effluent
Comp Ecology composite sample
grab grab sample
Comp Composite sample

E Ecology sample
Y Yakima sample
I Industrial influent to sprayfields
* Pre-dechlorination
** Sample collected from right channel.

Organics/Metals

Organic and metals data are summarized in Tables 6 and 7 (compounds detected) and in Appendix E (all compounds). Organic analysis revealed a small number of detected VOA and BNA compounds in the effluent, although none exceeded EPA water quality criteria (Table 6-EPA, 1986). Several pesticides were also detected in the municipal effluent, but these too were less than the EPA water quality acute and chronic criteria. A fair number of compounds were detected in the influent, the largest concentration being methylene chloride. Analysis of influent VOAs, BNAs, pesticides, and PCBs found several that exceeded EPA water quality chronic criteria; but all were subsequently reduced to below criteria across the STP.

Priority pollutant metals analysis identified concentrations of copper, lead, and silver in the effluent that surpassed EPA water quality chronic criteria (Table 7 - EPA, 1986). None exceeded acute criteria. The comparisons are between the effluent concentrations and the EPA water quality criteria and do not consider any mixing with the receiving water that may occur.

Bioassays

Daphnia pulex and rainbow trout results exhibited no acute toxicity (Table 8). Microtox results indicated some effects with an estimated EC_{50} of 48% effluent concentration.

Chronic effects were noted in both chronic tests. Based on statistical analysis Fathead minnow results for survival displayed no chronic effects (LOEC > 100%). A 75% survival rate at 100% effluent concentration would suggest some caution in interpreting this result. A chronic effect at the high concentration was observed for the growth test. Fathead Minnow growth in the 100% effluent was 50% of the control and had an NOEC at 50% of effluent concentration. The *Ceriodaphnia dubia* survival test produced an NOEC of 25% effluent concentration. The NOEC for *Ceriodaphnia dubia* reproduction was less than 6.25% of effluent concentration. This data suggests that the effluent exhibits chronic toxicity.

Chlorine residual was detected in the effluent sample collected for bioassays. At the laboratory, chlorine residual was detected at 0.31 mg/L. These concentrations could produce adverse effects in toxicity tests prior to test initiation. Revised Ecology policy now requires that bioassay samples are collected either before chlorination or after dechlorination. (Ecology, 1993)

Sludge

Sludge results were compared to the EPA National Sewage Sludge Survey to learn if the Yakima sludge contained priority pollutant concentrations noticeably higher than national averages (Table 9-EPA, 1990). Only arsenic (43.7 mg/Kg-dry) exceeded one standard deviation from the geometric mean of all STPs in the survey. Copper, lead, and zinc exceeded the geometric mean, but were all within one standard deviation. All other metals were less than the geometric mean.

Table 6 - VOA, BNA, and Pesticide/PCB Detected - Yakima STP, 1992.

Location:	Inf-1-R	Inf-2-L	Inf-3-R	Inf-4-L	Inf-E-R	Inf-E-L	Ef-1	Ef-2	Ef-E	Sludge	I-Ef-1	I-Ef-2	I-Ef-E	EPA Water Quality Criteria Summary**	
Type:	grab	grab	grab	grab	E-comp	E-comp	grab	grab	E-comp	grab	grab	grab	E-comp		
Date:	10/6	10/6	10/6	10/6	10/6-7	10/6-7	10/6	10/6	10/6-7	10/6	10/6	10/6	10/6-7	Acute	Chronic
Time:	0919	0904	1430	1428	@	@	1055	1525	@	1325	0955	1500	@	Fresh	Fresh
Lab Log#:	418155	418156	418157	418158	418159	418160	418162	418163	418166	418171	418172	418173	418176		
VOA Compounds	(µg/L)	(µg/L)	(µg/L)	(µg/L)			(µg/L)	(µg/L)		(µg/Kg-dry)	(µg/L)	(µg/L)		(µg/L)	(µg/L)
Methylene Chloride	61	110	113	105			73	31		6400	409	406		11,000 *(a)	
Acetone	24 J	46 J	67 J	68 J			6.7 J	100 U		2000 J	42 J	44 J			
Carbon Disulfide	10 U	13	14	10			10 U	10 U		1000 U	37	38			
Chloroform	5.6 J	6.4 J	8.8 U	13			10 U	10 U		1000 J	5.2 J	4 J		28,900 *	1,240 *
Carbon Tetrachloride	10 U	10 U	10 U	2.4 J			10 U	10 U		1000 U	10 U	10 U		35,200 *	
Tetrachloroethene	10 U	10 U	2.9 J	5.3 J			10 U	10 U		1000 U	10 U	10 U		5,280 *	840 *
Ethylbenzene	10 U	10 U	2.7 U	2 J			10 U	10 U		1000 U	10 U	10 U		32,000 *	
Total Xylenes	10 U	10 U	9 U	3.5 J			10 U	10 U		1000 U	10 U	10 U			
BNA Compounds					(µg/L)	(µg/L)			(µg/L)	(µg/Kg-dry)			(µg/L)	(µg/L)	(µg/L)
Phenol					10 U	10 U			10 U	3700 J			10 J	10,200 *	2,560 *
1,4-Dichlorobenzene					2.2 J	0.8 J			0.5 J	8000 J			10 J	1,120 *(h)	763 *(h)
1,2-Dichlorobenzene					1.6 J	10 U			10 U	8000 U			10 U	1,120 *(h)	763 *(h)
4-Methylphenol					10 U	20			10 U	2200 J			10 J		
Naphthalene					1.1 J	1.2 J			10 U	8000 U			10 U	2,300 *	620 *
4-Chloroaniline					1.4 J	1.4 J			20 U	1900 J			20 J		
2-Methylnaphthalene					0.8 J	0.5 J			10 UJ	8000 U			10 U		
Diethyl Phthalate					6.2 J	7.8 J			0.3 J	8000 U			10 U	940 *(i)	3 *(i)
N-Nitrosodiphenylamine					18	48			10 U	1700 J			0.8 J	5,850 *(k)	
Phenanthrene					10 U	10 U			10 U	270 J			10 U		
Di-n-Butyl Phthalate					10 U	43 U			82 U	27000			10 U	940 *(i)	3 *(i)
Butylbenzyl Phthalate					15	18			8.5 U	2000 J			6.3 J	940 *(i)	3 *(i)
Bis(2-Ethylhexyl)Phthalate					29	31			10 U	17000			21	940 *(i)	3 *(i)
Di-n-Octyl Phthalate					1 J	3.4 J			10 U	8000 U			1 U	940 *(i)	3 *(i)
Indeno(1,2,3-cd)Pyrene					10 U	0.3 J			10 U	8000 U			10 U		
Pesticide/PCB Compounds					(µg/L)	(µg/L)			(µg/L)	(µg/Kg-dry)			(µg/L)	(µg/L)	(µg/L)
beta-BHC					0.04	0.05			0.02	0.17			0.01 U	100 *(q)	
gamma-BHC (Lindane)					0.03	0.06			0.01	0.01 U			0.01 U	2.0	0.08
4,4'-DDD					0.01 U	0.01			0.01 U	0.01 U			0.01 U	0.6 *	0.001 (u)
4,4'-DDE					0.01	0.02			0.01 U	0.01 U			0.01 U	1,050 *	0.001 (u)
4,4'-DDT					0.03	0.03			0.01 U	0.01 U			0.01 U	1.1 (u)	0.001 (u)
Endosulfan I					0.02	0.01			0.01 U	0.01 U			0.05	0.22 (s)	0.056 (s)
Endosulfan II					0.01 U	0.02			0.01 U	0.01 U			0.17	0.22 (s)	0.056 (s)
Endosulfan Sulfate					0.01 U	0.01 U			0.02	0.01 U			0.1	0.22 (s)	0.056 (s)

J The associated numerical result is an estimated quantity.
U The analyte was not detected at or above the reported result.
UJ The analyte was not detected at or above the reported estimated result.
Inf Influent
EF Effluent
* Insufficient data to develop criteria. Value presented is the LOEL - Lowest observable Effect Level.
** From EPA, 1986

L Left side of channel in direction of flow.
R Right side of channel in direction of flow.
I Industrial discharge to sprayfield
Sludge Centrifuge sludge extract
comp Composite samples.
River Receiving water: Yakima River.
grab Grab sample.
E Ecology sample.
[box] Exceeds chronic criteria

@ Composite collection times: 08:00-08:00.
a Total Halomethanes
h Total Dichlorobenzenes
i Total Phthalate Esters
k Total Nitrosamines
q Total BHCs
s Endosulfan
u DDT plus metabolites

Table 7 - Metals Detected - Yakima STP, 1992.

Location:	Inf-E-R	Inf-E-L	Ef-E	Sludge	I-Ef-E	River 1	EPA Water Quality Criteria Summary** Acute Fresh	Chronic Fresh
Type:	E-comp	E-comp	E-comp	grab	E-comp	grab		
Date:	10/6-7	10/6-7	10/6-7	10/6	10/6-7	10/6		
Time:	@	@	@	1325	@	1050		
Lab Log#:	418159	418160	418166	418171	418176	418177		
Total Recoverable Metals	(μg/L)	(μg/L)	(μg/L)	(mg/Kg-dry)	(μg/L)	(μg/L)	(μg/L)	(ug/L)
Hardness = 75								
Arsenic	2.4 P	1.7 P	1.6 P	43.7	1.5 U	1.5 U		
Pentavalent							850 #	48 #
Trivalent							360 #	190 #
Beryllium	1 U	1 U	1 U	0.14 P	1 U	1 U	130 *	5.3 *
Cadmium	1.92	0.81 B	0.14 PB	6.18	0.61 B		2.8 +	0.9 +
Chromium	5 U	5.1 P	11 P	33.9	5 U	5 U		
Hexavalent							16	11
Trivalent							1,372 +	164
Copper	87.8	82.9	11	851 E	51.8	3 U	14 +	9 +
Lead	25.9	18.6	3.3 P	142 N	4.1 P	1 U	57 +	2.2 +
Mercury	0.1 U	2.8	0.1 U	3.12	0.1 U	0.1 U	2.4	0.012
Nickel	10 U	10 U	10 U	19.9	10 U	10 U	1,112 +	124 +
Selenium	50 U	2 U	50 U	3.55	50 U	50 U	260	35
Silver	4	7.25	0.96 P	32.8 N	0.5 U	0.5 U	2.5 +	0.12
Zinc	227	204	51.9 U	1290	110 U	12 P	92 +	83 +

B Analyte was found in the analytical method blank, indicating the sample may have been contaminated.
E Reported result is an estimate because of the presence of interference.
N For metals analytes the spike sample recovery is not within control limits.
P The analyte was detected above the detection limit, but below the established minimum quantitation limit.
U The analyte was not detected at or above the reported result.
* Insufficient data to develop criteria. Value presented is the LOEL - Lowest Observed Effect Level.
\+ Hardness dependent criteria (75 mg/L used).
** From EPA, 1986

Inf Influent
EF Effluent
L Left side of channel in direction of flow.
R Right side of channel in direction of flow.
I Industrial discharge
Sludge Centrifuge sludge extract
comp Composite samples.
grab Grab sample.
@ Composite collection times: 08:00-08:00.
E Ecology sample.
River Receiving water: Yakima River.

[box] Exceeds Chronic criteria

Table 8 – Effluent Bioassay Results – Yakima STP, 1992.

NOTE: all tests were run on the effluent (Ef–GC sample) – lab log # 418168

Daphnia pulex – 48 hour survival test
(Daphnia pulex)

Sample	# Tested *	Percent Survival
Control	20	100
6.25 % Effluent	20	100
12.5 % Effluent	20	95
25 % Effluent	20	100
50 % Effluent	20	100
100 % Effluent	20	95

Acute
LC50 = >100 % effluent
LOEC = >100 % effluent

* 4 replicates of 5 organisms

Ceriodaphnia dubia – 7 day survival and reproduction test
(Ceriodaphnia dubia)

Sample	# Tested	Percent Survival	Mean # Young per Original Female
Control	10	90	14.2
6.25 % Effluent	10	80	7.1
12.5 % Effluent	10	80	6.9
25 % Effluent	10	80	7.9
50 % Effluent	10	40	3.9
100 % Effluent	10	0	0

Survival
NOEC = 25 % effluent
LOEC = 50 % effluent

Reproduction
NOEC < 6.25 % effluent

Fathead Minnow – 7 day survival and growth test
(Pimephales promelas)

Sample	# Tested *	Percent Survival	Average Dry Weight per Fish (mg)
Control	40	92.5	0.32
6.25 % Effluent	40	87.5	0.40
12.5 % Effluent	40	100.0	0.36
25 % Effluent	40	95.0	0.37
50 % Effluent	40	90.0	0.29
100 % Effluent	40	75.0	0.16

Survival
NOEC = >100 % effluent
LC50 = >100 % effluent

Growth
NOEC = 50 % effluent
LOEC = 100 % effluent

* four replicates of 10 organisms

Rainbow Trout – 96 hour survival test
(Oncorhynchus mykiss)

Sample	# Tested	Percent Survival
Control	30	100
100% Effluent	30	100

Microtox

Time	EC50 (%effluent)
15 minutes	>45 (EC50 = 48% – extrapolated from test concentrations)

NOEC	– no observable effects concentration
LOEC	– lowest observable effects concentration
LC50	– lethal concentration for 50% of the organisms
EC50	– effect concentration for 50% of the organisms

Table 9 – Comparison of Compounds Detected in Digested Sludge with the National Sewage Sludge Survey* – Yakima, 1993

Parameter	Location: Type: Lab Log #	Sludge grab 418171 (mg/Kg-dry)	Data from EPA Sludge Survey (EPA, 1990) Geometric Mean ** (mg/Kg-dry)	Geometric Mean + 1 S.D. (mg/Kg-dry)	Number of Samples	Percent Detected %
VOA COMPOUNDS						
	(VOA compounds evaluated by the NSSS were not detected in the sludge)					
BNA COMPOUNDS						
Bis(2-ethylhexyl) Phthalate		17	74.7	673	200	62
Pesticide/PCB						
	(Pesticide/PCB compounds evaluated by the NSSS were not detected in the sludge)					
METALS						
Arsenic		43.7	9.93	28.7	199	80
Beryllium		0.14 P	0.37	0.71	199	23
Cadmium		6.18	6.9	18.7	198	69
Chromium		33.9	118.6	458	199	91
Copper		851 E	741.0	1703	199	100
Lead		142 N	134.0	332	199	80
Mercury		3.12	5.22	20.8	199	63
Nickel		19.9	42.7	137.5	199	66
Selenium		3.55	5.16	12.5	199	65
Zinc		1290	1202	2756	199	100

* Geometric mean and variance are exponential conversions of arithmetic mean and variance for log-normal distributions and were derived utilizing the Method of Maximum Likelihood.

J Result is an estimate.

** In general, concentrations are a weighted combination of flow rate group estimates.

\## Weighted combination of only two flow groups: flow ≥ 100 MGD and 10 < flow < +100 MGD.

++ Estimate from one flow group: 1<flow<10

Several organic compounds were also detected in the sludge (Table 6). Of these only bis(2-ethylhexyl)phthalate was evaluated in the sludge survey. The concentration in the Yakima sludge was less than the geometric mean from the national sludge survey.

Land application of sludge should be evaluated based on guidelines and limits included in the EPA sludge regulations (EPA, 1993).

Industrial Wastewater Treatment

General Chemistry

The industrial effluent was typical of food processing wastewater (Table 3). The concentration of BOD_5 was high (Ecology result >700mg/L), TSS concentration was moderate, and nutrient concentrations were low. During the inspection crop growth on the sprayfield was sparse. The sprayfield operator reported the area had recently been tilled and reseeded. Establishing and maintaining a good stand of cover in the sprayfields has proven elusive. Also weeds are a frequent problem.

Inspection water quality data are compared to several guidelines pertaining to the use of wastewater for irrigation (Table 10 - Metcalf & Eddy, 1991). Adjusted Sodium Adsorption Ratio ($adjR_{Na}$) calculations suggest moderate impact on water infiltration rates in sprayfield soils may occur due to wastewater application. Salinity in the industrial wastewater as calculated from conductivity was expected to have no impact in terms of crop water availability. The pH of the wastewater (4.55 - 4.98) was below the range for normal crop growth. Total nitrogen (Kjeldahl-N + NO_2-N + NO_3-N) concentrations were in the range that may cause slight to moderate inhibition of crop growth. Yakima should investigate the industrial wastewater to determine if the wastewater quality is suitable for the spray program being used.

High fecal (190000-220000 #/100ml) and total coliform (>400000 #/100ml) counts were detected in the industrial wastewater (Table 3). These levels could pose problems as a source of ground water contamination and as inadvertent runoff into the Yakima River. Monitoring by Yakima to determine typical coliform concentrations being sent to the sprayfield is recommended. The data generated should be compared to any applicable guidelines for land application of wastewater.

Of note, was an old concrete sewer pipe, approximately 36 inches in diameter, running beneath the sprayfield and emptying directly into the Yakima River. A pool of water from the pipe had collected in a small basin just adjacent to the River. Mats of bacterial growth and various other organisms were found in the water and on surrounding rocks. TOC concentration exceeded 130 mg/L (AgOut sample - Table 3). Although the actual source of this wastestream was unknown, the operator indicated it originates beyond the sprayfield boundaries. Any breaks in the pipe under the sprayfield could act as a direct conduit of land applied industrial wastewater into the Yakima River. The pipe should be investigated, the water quality characterized, and appropriated action taken.

Table 10 – Guidelines for Interpretations of Water Quality for Irrigation* – Yakima, 1992

Potential Irrigation Problems	Units	Degree of Restrictions on Use: None	Slight to Moderate	Severe	Yakima Sprayfield Industrial Wastewater**
Salinity (affects crop water availability)					
ECw	dS/m or mmho/cm	<0.7	0.7–3.0	>3.0	0.26¤
Permeability (affects infiltration rate of water into the soil soil. Evaluate using ECw & adj RNa***)					
Range: adjRNa = < 0.3 and ECw =		≥0.7	0.7–0.2	<0.2	adjRNa: 0.282 ECw = 0.26
Micellaneous Effects (affects susceptible crops)					
Nitrogen (Total-N)	mg/L	<5	5–30	>30	12.5
pH	mg/L		Normal range 6.5–8.4		4.6;5.0 △

* Metcalf & Eddy, 1991, pg. 1146.
** Data from Industrial Effluent samples: 418172, 418173, & 418176
*** Adjusted Sodium Adsoption Ratio
△ pH values for the two industrial influent grabs (418172 & 418173).
¤ derived from conductivity
ECw Salinity of wastewater
adjRNa Adjusted Sodium Adsorption Ratio

Organics/Metals

A number of VOAs, BNAs, and PCBs/Pesticides were detected in the industrial wastewater prior to sprayfield application (Table 6). Four (butylbenzyl phthalate, bis(2-ethylhexyl)phthalate, endosulfan II, and endosulfan sulfate) exceeded EPA water quality chronic criteria (EPA, 1986). Although concentrations exceeded chronic criteria for receiving waters, the effluent is land applied to sprayfields so these criteria are not directly applicable. Methylene chloride was found at the highest concentration (406 & 409 μg/L).

Only three metals were detected in the industrial effluent (Table 7). The cadmium concentration was less than both acute and chronic receiving water criteria. Copper exceeded both acute and chronic EPA water quality criteria. Lead exceeded the chronic criteria. Several metal detection limits were above either chronic or acute criteria. Although some concentrations exceeded acute or chronic criteria for receiving waters, the effluent is land applied to sprayfields so these criteria are not directly applicable.

CONCLUSIONS AND RECOMMENDATIONS

Domestic Wastewater Treatment

Flow Measurement

Ecology's instantaneous flow measurements matched well with Yakima metering devices. The flow rate during the inspection exceeded 85% of permit design capacity for monthly average flow included in the NPDES permit. Should flows frequently exceed 85% of monthly design capacity, the design capacity should be modified to reflect any plant improvements, or a plan and schedule for continuing adequate treatment capacity should be submitted to Ecology.

NPDES Permit Compliance

Most parameters were within NPDES permit effluent limits and influent loading criteria. Exceptions included:

- Effluent total ammonia results exceeded the calculated NPDES permit chronic monthly limit. It is recommended that steps be taken to improve nitrification in the aeration basins.

- Ecology fecal coliform grab sample results exceeded the NPDES permit monthly average limit. A new chlorination system had been installed, but was not fully operational at the time of the inspection. The new system could be fine tuned to provide lower counts.

- Influent BOD_5 loading exceeded the average monthly design capacity included in the NPDES permit. Should BOD_5 loading frequently exceed 85% of design capacity, the design capacity should be modified to reflect any plant improvements, or a plan and schedule for continuing to maintain adequate treatment capacity should be submitted to Ecology.

General Chemistry/Plant Operation

BOD_5 and TSS removal through the plant was greater than 90%. Effluent NH_3-N concentrations suggest little nitrification was occurring across the plant.

Ecology composite samples found differences in influent quality between two influent channels. Yakima should conduct a survey of the quality in both channels to determine if differences occur frequently enough to require routine composite sampling in both channels.

Sample Splits

Ecology laboratory analysis found a reasonable correspondence between Ecology's and Yakima's samples. Yakima should routinely (at least weekly) check composite sample temperatures to assure that they are adequately cooled during collection.

Comparisons between the two laboratories' analyses of split samples found some differences in fecal coliform, TSS, and NH_3 results. It is suggested that Yakima review their fecal coliform testing protocol. If necessary, they could seek assistance from Ecology's Laboratory Accreditation Section.

Organics/Metals

Several organic compounds were detected in both the influent and effluent. All effluent concentrations were less than EPA water quality criteria (EPA, 1986). Three metals detected in the effluent (Cu, Pb, and Ag) did exceed the EPA water quality chronic criteria. Dilution in an allowed mixing zone could reduce the concentrations below the water quality criteria. Monitoring of these metals should be continued.

Bioassays

Fathead minnow (growth NOEC = 50% effluent) and *Ceriodaphnia dubia* (survival NOEC = 25% effluent and reproduction NOEC < 6.25%) bioassays provided evidence of chronic effects. Ecology also observed some effects in the Microtox bioassays (EC_{50} = 48%). The toxicity may have been caused by chlorine residual in the sample during the analysis.

Sludge

Comparison to the EPA National Sewage Sludge Survey found most organic and metals detected in the Yakima sludge at concentrations less than the survey's geometric mean plus one standard deviation. The exception was arsenic which exceeded one standard deviation from the mean.

Sludge use or disposal should be evaluated based on the guidelines and limits included in the EPA sludge regulations (EPA, 1993).

Industrial Wastewater Treatment

General Chemistry

The industrial effluent was fairly typical of food processing wastewater. The portion of the sprayfield observed had sparse ground cover. Comparison of inspection data to guidelines for the use of wastewater for irrigation (Metcalf & Eddy, 1991) suggest the Adjusted Sodium Adsorption Ratio, pH, and the total-N concentrations may inhibit normal plant growth to some degree. Yakima should further investigate the quality of the industrial wastewater to determine if it is suitable for the spray program being used.

High fecal and total coliform counts were found in the industrial wastewater. Monitoring and comparison to any applicable land application of wastewater guidelines and regulations are recommended.

The pipe running beneath the sprayfield should be investigated for infiltration from the sprayfield, its water quality characterized, and appropriate action taken if problems are identified.

Organics/Metals

Ecology detected a number of organics in the industrial wastewater and several exceeded the EPA's chronic water quality criteria, although for sprayfield application these criteria do not strictly apply. Copper exceeded the EPA's acute and chronic water quality criteria. Lead exceeded the chronic criteria. An investigation of the need to remove these compounds prior to irrigation should be considered.

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APPENDICES

Appendix A - Sampling Stations Descriptions - Yakima STP, 1992

Inf-R	Influent in right channel looking downstream (West side) - Ecology grab collected at the flow splitter upstream of the primary clarifiers.
Inf-L	Influent in left channel looking downstream (East side) - Ecology grab collected at the flow splitter upstream of the primary clarifiers.
Inf-E-R	Influent wastewater in the right channel (West side) - Ecology composite collected at the flow splitter upstream of the primary clarifiers.
Inf-E-L	Influent wastewater in the left channel (East side) - Ecology composite collected at the flow splitter upstream of the primary clarifiers.
Inf-Y	Influent wastestream in the right channel (West side) - Yakima composite sample collected at the flow splitter upstream of the primary clarifiers.
Ef	Effluent from the end of chlorine contact chamber - Ecology collected grab just before weir overflow.
Ef-E	Effluent out of chlorine contact chamber - Ecology composite collected before the weir overflow.
Ef-Y	Effluent out of chlorine contact chamber - Yakima composite collected before the weir overflow.
Ef-GC	Effluent from the end of the chlorine contact chamber - Ecology grab-composite collected in the AM and PM from just before the weir overflow.
Aer-Mix	Mixed liquor from the aeration basins - Ecology collected grabs.
Sludge	Sludge from digester system - Ecology collected grab from truck just after the centrifuge.
I-Ef	Industrial wastewater - Ecology collected grabs from the wetwell just after screening of influent.
I-Ef-E	Industrial wastewater - Ecology collected composites from wetwell just after screening of influent.
River-1	Yakima River water - Ecology collected grabs from the bank of the Yakima River at the outflow. (Lat/Long: 46°34′40″/120°27′53″)
River-2	Yakima River water - Ecology collected grabs from the bank of the Yakima River downstream from the outfall. (Lat/Long: 46°34′47″/120°27′42″)
Ground	Ground water pumped from beneath aeration basins - Ecology collected one grab sample.
AgOut	Wastewater from storm pipe under sprayfield - Ecology collected grab from outflow pond.

Appendix B - Sampling Schedule, Yakima STP, 1992

Parameter	Inf-1-R	Inf-2-L	Inf-3-R	Inf-4-L	Inf-E-R	Inf-E-L	Inf-Y	Ef-1	Ef-1-A	Ef-2	Ef-3	Ef-4	Ef-E	Ef-Y
Type:	grab	grab	grab	grab	E-comp	E-comp	Y-comp	grab	grab	grab	grab	grab	E-comp	Y-comp
Date:	10/6	10/6	10/6	10/6	10/6-7	10/6-7	10/6-7	10/6	10/6	10/6	10/7	10/7	10/6-7	10/6-7
Time:	0919	0904	1430	1428	@	@	@	1055	1245	1525	0825	1210	@	@
Lab Log #:	418155	418156	418157	418158	418159	418160	418161	418162		418163	418164	418165	418166	418167
GENERAL CHEMISTRY														
Conductivity	E	E	E	E	E	E	E	E		E			E	E
Alkalinity					E	E	E						E	E
Hardness					E	E	E						E	E
SOLIDS 4														
TS					E	E							E	
TNVS					E	E							E	
TSS	E	E	E	E	EY	EY	EY	E		E			EY	EY
TNVSS					E	E							E	
% Solids														
% Volatile Solids														
OXYGEN DEMAND PARAMETERS														
BOD5					EY	EY	EY						EY	EY
BOD INH					E	E	E						E	E
BOD35													E	
COD					E	E	E						E	E
TOC (water)	E	E	E	E	E	E	E	E		E			E	E
TOC (soil/sed)														
NUTRIENTS														
Total Persulfate N					EY	EY	EY						E	E
NH3-N					E	E	E	E		E			EY	EY
NO2+NO3-N					E	E	E	E		E			E	E
Total-P					E	E	E	E		E			E	E
MISCELLANEOUS														
Oil and Grease (water)	E	E	E	E				E		E				
F-Coliform MF											EY	EY		
T-Coliform MF														
ORGANICS														
VOC (water)	E	E	E	E				E		E				
VOC (soil/sed)														
BNA (water)					E	E							E	
BNAs (soil/sed)														
Pest/PCB (water)					E	E							E	
Pest/PCB (soil/sed)														
METALS														
PP Metals (water)					E	E							E	
PP Metals (soil/sed)														
SAR PARAMETERS														
HCO3														
CA														
Mg														
Na														
BIOASSAYS														
Salmonid (acute 100%)														
Microtox (acute)														
Daphnia pulex (acute)														
Ceriodaphnia (chronic)														
Fathead Minnow (chronic)														
FIELD OBSERVATIONS														
Temperature	E	E	E	E	E	E	E	E	E	E	E	E	E	E
pH	E	E	E	E	E	E	E	E	E	E	EY	EY	E	E
Conductivity	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Chlorine								E		E	E	E	E	E

E Ecology sample/analysis
Y Yakima sample/analysis
grab Grab Sample
comp Composite Sample
A Duplicate grab

Inf Influent
Ef Effluent
R Right influent channel
L Left influent channel
@ Composite collection period: 08:00-08:00.

Appendix B – Sampling Schedule, Yakima STP, 1992

Parameter II Locatn:	Ef–GC	Aer–Mix–1	Aer–Mix–2	Sludge	I–Ef–1	I–Ef–2	I–Ef–3	I–Ef–4	I–Ef–E	River 1	River 2	Ground	AgOut
Type:	ab–comp	grab	grab	grab	grab	grab	grab	grab	E–comp	grab	grab	grab	grab
Date:	10/6	10/6	10/6	10/6	10/6	10/6	10/6	10/6	10/6–7	10/6	10/6	10/6	10/6
Time:	AM&PM	1105	1600	1325	0955	1500	0900	1155	@	1050	1050	1612	1115
Lab Log #:	418168	418169	418170	418171	418172	418173	418174	418175	418176	418177	418178	418179	418180
GENERAL CHEMISTRY													
Conductivity	E				E	E			E	E			E
Alkalinity	E								E	E			
Hardness	E								E	E			
SOLIDS 4													
TS									E				
TNVS									E				
TSS		E	E		E	E			EY			E	E
TNVSS		E	E						E				
% Solids				E									
% Volatile Solids				E									
OXYGEN DEMAND PARAMETERS													
BOD5									EY				
BOD INH									E				
BOD35													
COD									E				
TOC (water)					E	E			E			E	E
TOC (soil/sed)				E									
NUTRIENTS													
Total Persulfate N									E				
NH3–N									EY	E	E	E	E
NO2+NO3–N									E			E	E
Total–P									E			E	E
MISCELLANEOUS													
Oil and Grease (water)					E	E							
F–Coliform MF							EY	EY					
T–Coliform MF							E	E					
ORGANICS													
VOC (water)					E	E							
VOC (soil/sed)				E									
BNA (water)									E				
BNAs (soil/sed)				E									
Pest/PCB (water)									E				
Pest/PCB (soil/sed)				E									
METALS													
PP Metals (water)									E	E			
PP Metals (soil/sed)				E									
SAR PARAMETERS													
HCO3					E	E							
CA					E	E							
Mg					E	E							
Na					E	E							
BIOASSAYS													
Salmonid (acute 100%)	E												
Microtox (acute)	E												
Daphnia pulex (acute)	E												
Ceriodaphnia (chronic)	E												
Fathead Minnow (chronic)	E												
FIELD OBSERVATIONS													
Temperature					E	E	E	E	E	E	E	E	E
pH					E	E	EY	EY	E	E	E	E	E
Conductivity					E	E	E	E	E	E	E	E	E
Chlorine							E						

gr–comp Grab–composite
Inf Influent
Ef Effluent
Aer–Mix Aeration Basin Mixed Liquor
Sludge Centrifuge sludge extract

E Ecology sample/analysis
Y Yakima sample/analysis
River Yakima River
AgOut Storm pipe under sprayfield – Discharge to Yakima River
Ground Groundwater pumped from beneath aeration basins.

@ Composite collection period: 08:00–08:00.

Apendix C – Analytic Procedures and Laboratories, Yakima, 1992.

Parameter IV	MANCHESTER_METHODS	Lab Used
GENERAL CHEMISTRY		
Conductivity (umhos/cm)	EPA, Revised 1983: 120.1	Ecology
Alkalinity (mg/L CaCO3)	EPA, Revised 1983: 310.1	Ecology
Hardness (mg/L CaCO3)	EPA, Revised 1983: 130.2	Ecology
SOLIDS		
TS (mg/L)	EPA, Revised 1983: 160.3	Ecology
TNVS (mg/L)	EPA, Revised 1983: 160.3	Ecology
TSS (mg/L)	EPA, Revised 1983: 160.2	Ecology
TNVSS (mg/L)	EPA, Revised 1983: 160.2	Ecology
% Solids	APHA, 1989: 2540G.	Water Management Laboratories
% Volatile Solids(wet)	EPA, Revised 1983: 160.4	Water Management Laboratories
OXYGEN DEMAND PARAMETERS		
BOD5 (mg/L)	EPA, Revised 1983: 405.1	Water Management Laboratories
BOD INH (mg/L)	EPA, Revised 1983: 405.1	Water Management Laboratories
BOD35 (mg/L)	EPA, Revised 1983: 405.1	Water Management Laboratories
COD (mg/L)	EPA, Revised 1983: 410.1	Water Management Laboratories
TOC (water mg/L)	EPA, Revised 1983: 415.1	Water Management Laboratories
TOC (soil)	EPA, Revised 1983: 415.1	Water Management Laboratories
NUTRIENTS		
Kjeldahl–N	EPA, Revised 1983: 351.3	Water Management Laboratories
NH3–N (mg/L)	EPA, Revised 1983: 350.1	Ecology
NO2+NO3–N (mg/L)	EPA, Revised 1983: 353.2	Ecology
Total–P (mg/L)	EPA, Revised 1983: 365.3	Ecology
MISCELLANEOUS		
Oil and Grease (mg/L)	EPA, Revised 1983: 413.1	Ecology
F–Coliform MF (#/100mL)	APHA, 1989: 9222D.	Ecology
T–Coliform MF (#/100mL)	APHA, 1989: 9222B.	Ecology
ORGANICS		
VOC (water–ug/L)	EPA, 1986: 8260	Sound Analytical Services
VOC (soil–ug/kg)	EPA, 1986: 8240	Sound Analytical Services
BNAs (water–ug/L)	EPA, 1986: 8270	Sound Analytical Services
BNAs (soil–ug/kg)	EPA, 1986: 8270	Sound Analytical Services
Pest/PCB (water–ug/L)	EPA, 1986: 8080	Sound Analytical Services
Pest/PCB (soil–ug/kg)	EPA, 1986: 8080	Sound Analytical Services
METALS		
PP Metals (water)	EPA, Revised 1983: 200–299	Ecology
PP Metals (soil/sed)	EPA, Revised 1983: 200–299	Ecology
SAR PARAMETERS		
HCO3 (mg/L)	EPA, Revised 1983: 120.1	Ecology
Ca (mg/L)	EPA, Revised 1983: 200–299	Ecology
Mg (mg/L)	EPA, Revised 1983: 200–299	Ecology
Na (mg/L)	EPA, Revised 1983: 200–299	Ecology
BIOASSAYS		
Salmonid (acute 100%)	Ecology, 1981.	Parametrix, Inc.
Microtox (acute)	Beckman, 1982	Parametrix, Inc.
Daphnia sp. (acute)	ASTM, 1986	Parametrix, Inc.
Ceriodaphnia (chronic)	EPA 1989: 1002.0	Parametrix, Inc.
Fathead Minnow (chronic)	EPA 1989: 1000.0	Parametrix, Inc.

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Appendix D - Priority Pollutant Cleaning Procedures - Yakima, 1992.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURES

1. wash with laboratory detergent,
2. rinse several times with tap water,
3. rinse with 10% HNO_3 solution,
4. rinse three (3) times with distilled/deionized water,
5. rinse with high purity methylene chloride,
6. rinse with high purity acetone, and
7. allow to dry and seal with aluminum foil.

Appendix E – VOA, BNA, Pesticide/PCB and Metals Scan Results – Yakima STP, 1992.

Location:	Inf-1-R	Inf-2-L	Inf-3-R	Inf-4-L	Ef-1	Ef-2	Sludge	I-Ef-1	I-Ef-2
Type:	grab	grab	grab	grab	grab	grab	grab	grab	grab
Date:	10/6	10/6	10/6	10/6	10/6	10/6	10/6	10/6	10/6
Time:	0919	0904	1430	1428	1055	1525	1325	0955	1500
Lab Log#:	418155	418156	418157	418158	418162	418163	418171	418172	418173
VOA Compounds	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/Kg-dry)	(µg/L)	(µg/L)
Chloromethane	20 U	20 U	20 U	20 U	20 U	20 U	2000 U	20 U	20 U
Bromomethane	20 U	20 U	20 U	20 U	20 U	20 U	2000 U	20 U	20 U
Vinyl Chloride	20 U	20 U	20 U	20 U	20 U	20 U	2000 U	20 U	20 U
Chloroethane	20 U	20 U	20 U	20 U	20 U	20 U	2000 U	20 U	20 U
Methylene Chloride	61	110	113	105	73	31	6400	409	406
Acetone	24 J	46 J	67 J	68 J	6.7 J	100 U	2000 J	42 J	44 J
Carbon Disulfide	10 U	13	14	10	10 U	10 U	1000 U	37	38
1,1-Dichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
1,2-Dichloroethene (total)	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Chloroform	5.6 J	6.4 J	8.8 U	13	10 U	10 U	1000 J	5.2 J	4 J
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
2-Butanone (MEK)	50 U	50 U	50 U	50 U	50 U	50 U	5000 U	50 U	12 J
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Carbon Tetrachloride	10 U	10 U	10 U	2.4 J	10 U	10 U	1000 U	10 U	10 U
Vinyl Acetate	50 U	50 U	50 U	50 U	50 U	50 U	5000 U	50 U	50 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Dibromochloromethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
4-Methyl-2-Pentanone	50 U	50 U	50 U	50 U	50 U	50 U	5000 U	50 U	50 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Tetrachloroethene	10 U	10 U	2.9 J	5.3 J	10 U	10 U	1000 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Toluene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Ethylbenzene	10 U	10 U	2.7 U	2 J	10 U	10 U	1000 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U	10 U	10 U	1000 U	10 U	10 U
Total Xylenes	10 U	10 U	9 U	3.5 J	10 U	10 U	1000 U	10 U	10 U

U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
Sludge Centrifuge sludge extract
Inf Influent
EF Effluent
grab Grab sample.
L Left side of channel in direction of flow.
R Right side of channel in direction of flow.
I Industrial discharge

Location:	Inf-E-R	Inf-E-L	Ef-E	Sludge	I-Ef-E
Type:	E-comp	E-comp	E-comp	grab	E-comp
Date:	10/6–7	10/6–7	10/6–7	10/6	10/6–7
Time:	@	@	@	1325	@
Lab Log#:	418159	418160	418166	418171	418176
BNA Compounds	(µg/L)	(µg/L)	(µg/L)	(µg/Kg-dry)	(µg/L)
Phenol	10 U	10 U	10 U	3700 J	10 J
Bis(2-Chloroethyl)Ether	10 U	10 U	10 U	8000 U	10 U
2-Chlorophenol	10 U	10 U	10 U	8000 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	8000 U	10 U
1,4-Dichlorobenzene	2.2 J	0.8 J	0.5 J	8000 J	10 J
Benzyl Alcohol	20 U	20 U	20 U	16000 U	20 U
1,2-Dichlorobenzene	1.6 J	10 U	10 U	8000 U	10 U
2-Methylphenol	10 U	10 U	10 U	8000 U	10 U
Bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	8000 U	10 U
4-Methylphenol	10 U	20	10 U	2200 J	10 J
N-Nitroso-di-n-Propylamine	10 U	10 U	10 U	8000 U	10 U
Hexachloroethane	10 U	10 U	10 U	8000 U	10 U
Nitrobenzene	10 U	10 U	10 U	8000 U	10 U
Isophorone	10 U	10 U	10 U	8000 U	10 U
2-Nitrophenol	10 U	10 U	10 U	8000 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	8000 U	10 U
Benzoic Acid	50 UJ	50 UJ	50 UJ	40000 UJ	9 UJ
Bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	8000 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	8000 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	8000 U	10 U
Naphthalene	1.1 J	1.2 J	10 U	8000 U	10 U
4-Chloroaniline	1.4 J	1.4 J	20 U	1900 J	20 J
Hexachlorobutadiene	10 U	10 U	10 U	8000 U	10 U
4-Chloro-3-Methylphenol	20 U	20 U	20 U	16000 U	20 U
2-Methylnaphthalene	0.8 J	0.5 J	10 UJ	8000 U	10 U
Hexachlorocyclopentadiene	10 UJ	10 UJ	10 UJ	8000 UJ	10 UJ
2,4,6-Trichlorophenol	10 U	10 U	10 U	8000 U	10 U
2,4,5-Trichlorophenol	10 U	10 U	10 U	8000 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U	8000 U	10 U
2-Nitroaniline	50 U	50 U	50 U	40000 U	50 U
Dimethyl Phthalate	10 U	10 U	10 U	8000 U	10 U
Acenaphthylene	10 U	10 U	10 U	8000 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	8000 U	10 U
3-Nitroaniline	50 U	50 U	50 U	40000 U	50 U
Acenaphthene	10 U	10 U	10 U	8000 U	10 U

U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
UJ The analyte was not detected at or above the reported estimated result.
Inf Influent
EF Effluent
L Left side of channel in direction of flow.
R Right side of channel in direction of flow.
I Industrial discharge

Sludge Centrifuge sludge extract
comp Composite samples.
grab Grab sample.
@ Composite collection times: 08:00–08:00.
E Ecology sample.

Location:	Inf-E-R	Inf-E-L	Ef-E	Sludge	I-Ef-E
Type:	E-comp	E-comp	E-comp	grab	E-comp
Date:	10/6-7	10/6-7	10/6-7	10/6	10/6-7
Time:	@	@	@	1325	@
Lab Log#:	418159	418160	418166	418171	418176
BNA Compounds	(μg/L)	(μg/L)	(μg/L)	(μg/Kg-dry)	(μg/L)
2,4-Dinitrophenol	50 U	50 U	50 U	40000 U	50 U
4-Nitrophenol	50 U	50 U	50 U	40000 U	50 U
Dibenzofuran	10 U	10 U	10 U	8000 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	8000 U	10 U
Diethyl Phthalate	6.2 J	7.8 J	0.3 J	8000 U	10 U
4-Chlorophenyl Phenylether	10 U	10 U	10 U	8000 U	10 U
Fluorene	10 U	10 U	10 U	8000 U	10 U
4-Nitroaniline	50 U	50 U	50 U	40000 U	50 U
4,6-Dinitro-2-Methylphenol	50 UJ	50 UJ	50 UJ	40000 UJ	50 UJ
N-Nitrosodiphenylamine	18	48	10 U	1700 J	0.8 J
4-Bromophenyl Phenylether	10 U	10 U	10 U	8000 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	8000 U	10 U
Pentachlorophenol	50 U	50 U	50 U	40000 U	50 U
Phenanthrene	10 U	10 U	10 U	270 J	10 U
Anthracene	10 U	10 U	10 U	8000 U	10 U
Di-n-Butyl Phthalate	10 U	43 U	82 U	27000	10 U
Fluoranthene	10 U	10 U	10 U	8000 U	10 U
Pyrene	10 U	10 U	10 U	8000 U	10 U
Butylbenzyl Phthalate	15	18	8.5 U	2000 J	6.3 J
3,3'-Dichlorobenzidine	20 U	20 U	20 U	16000 U	20 U
Benzo(a)Anthracene	10 U	10 U	10 U	8000 U	10 U
Chrysene	10 U	10 U	10 U	8000 U	10 U
Bis(2-Ethylhexyl)Phthalate	29	31	10 U	17000	21
Di-n-Octyl Phthalate	1 J	3.4 J	10 U	8000 U	1 U
Benzo(b)Fluoranthene	10 U	10 U	10 U	8000 U	10 U
Benzo(k)Fluoranthene	10 U	10 U	10 U	8000 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	8000 U	10 U
Indeno(1,2,3-cd)Pyrene	10 U	0.3 J	10 U	8000 U	10 U
Dibenzo(a,h)Anthracene	10 U	10 U	10 U	8000 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	8000 U	10 U

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R Right side of channel in direction of flow.
I Industrial discharge

Sludge Centrifuge sludge extract
comp Composite samples.
grab Grab sample.
@ Composite collection times: 08:00-08:00.
E Ecology sample.

Location:		Inf-E-R	Inf-E-L	Ef-E	Sludge	I-Ef-E
Type:		E-comp	E-comp	E-comp	grab	E-comp
Date:		10/6–7	10/6–7	10/6–7	10/6	10/6–7
Time:		@	@	@	1325	@
Lab Log#:		418159	418160	418166	418171	418176
Pesticide/PCB Compounds	ug/L	(µg/L)	(µg/L)	(µg/L)	(µg/Kg-dry)	(µg/L)
Aldrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
alpha-BHC		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
beta-BHC		0.04	0.05	0.02	0.17	0.01 U
delta-BHC		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
gamma-BHC (Lindane)		0.03	0.06	0.01	0.01 U	0.01 U
Chlordane		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD		0.01 U	0.01	0.01 U	0.01 U	0.01 U
4,4'-DDE		0.01	0.02	0.01 U	0.01 U	0.01 U
4,4'-DDT		0.03	0.03	0.01 U	0.01 U	0.01 U
Dieldrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Endosulfan I		0.02	0.01	0.01 U	0.01 U	0.05
Endosulfan II		0.01 U	0.02	0.01 U	0.01 U	0.17
Endosulfan Sulfate		0.01 U	0.01 U	0.02	0.01 U	0.1
Endrin		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Endrin Aldehyde		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Heptachlor		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Heptachlor Epoxide		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Endrin Ketone		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Methoxychlor		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Toxaphene		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor-1016		1 U	1 U	1 U	1 U	1 U
Aroclor-1221		1 U	1 U	1 U	1 U	1 U
Aroclor-1232		1 U	1 U	1 U	1 U	1 U
Aroclor-1242		1 U	1 U	1 U	1 U	1 U
Aroclor-1248		1 U	1 U	1 U	1 U	1 U
Aroclor-1254		1 U	1 U	1 U	1 U	1 U
Aroclor-1260		1 U	1 U	1 U	1 U	1 U
Aroclor-1262		1 U	1 U	1 U	1 U	1 U
Aroclor-1268		1 U	1 U	1 U	1 U	1 U

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Sludge Centrifuge sludge extract
comp Composite samples.
grab Grab sample.
@ Composite collection times: 08:00–08:00.
E Ecology sample.

Location:	Inf-E-R	Inf-E-L	Ef-E	Sludge	I-Ef-E	River 1
Type:	E-comp	E-comp	E-comp	grab	E-comp	grab
Date:	10/6–7	10/6–7	10/6–7	10/6	10/6–7	10/6
Time:	@	@	@	1325	@	1050
Lab Log#:	418159	418160	418166	418171	418176	418177
Total Recoverable Metals	(µg/L)	(µg/L)	(µg/L)	mg/Kg-dry	(µg/L)	(µg/L)
Hardness = 75						
Arsenic	2.4 P	1.7 P	1.6 P	43.7	1.5 U	1.5 U
Beryllium	1 U	1 U	1 U	0.14 P	1 U	1 U
Cadmium	1.92	0.81 B	0.14 PB	6.18	0.61 B	
Chromium	5 U	5.1 P	11 P	33.9	5 U	5 U
Copper	87.8	82.9	11	851 E	51.8	3 U
Lead	25.9	18.6	3.3 P	142 N	4.1 P	1 U
Mercury	0.1 U	2.8	0.1 U	3.12	0.1 U	0.1 U
Nickel	10 U	10 U	10 U	19.9	10 U	10 U
Selenium	50 U	2 U	50 U	3.55	50 U	50 U
Silver	4	7.25	0.96 P	32.8 N	0.5 U	0.5 U
Thallium	2.5 U	2.5 U	2.5 U		2.5 U	2.5 U
Zinc	227	204	51.9 U	1290	110 U	12 P

B Analyte was found in the analytical method blank, indicating the sample may have been contaminated.
E Reported result is an estimate because of the presence of interference.
N For metals analytes the spike sample recovery is not within control limits.
P The analyte was detected above the detection limit, but below the established minimum quantitation limit.
U The analyte was not detected at or above the reported result.
River Receiving water: Yakima River.

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